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# IQSY SOLAR ECLIPSE SCIENTIFIC EXPEDITION

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MAY 30 ECLIPSE IN SOUTH PACIFIC

TIMELY TO WORLD-WIDE STUDY OF QUIET SUN

WASHINGTON—Scientists from many parts of the world will converge on a narrow, 8,000-mile corridor of the South Pacific Sunday, May 30, to view the 38th total eclipse of the sun during this century.

The eclipse observations, in which U. S. scientists will take a major part, constitute an important contribution to the current world-wide study of the sun and its effects on the earth.

This scientific program, which began January 1, 1964, and will continue through 1965, is designated the International Years of the Quiet Sun (IQSY), because it takes place during a low point in the 11-year cycle of sunspot and solar flare activity.

Scientists of 70 nations are participating in the effort to disentangle some of the complexities of the sun-earth interaction demonstrated during the International Geophysical Year in 1957-58, which was timed to coincide with the most recent period of maximum solar activity and, in fact, benefited from the most active maximum ever recorded.

IQSY studies are attempting to establish the quiet-day conditions upon which the sun's explosive processes are superimposed. By studying in detail solar events which are relatively isolated in time, it is hoped that progress can be made in understanding the conditions of equilibrium between the turbulent solar atmosphere and the terrestrial environment, and the disturbances originating near the sun's surface which upset that equilibrium.

The eclipse, a product of the celestial coincidence that the moon is of just the right size and at just the right distance to cover the sun's disk but not its atmosphere, contributes to the objectives of the IQSY by providing a glimpse of solar events otherwise masked by the bright sky and the intense light from the sun itself. The observations will include:

- ¶ Direct photography of the extended outer atmosphere of the sun, or corona. During solar quiet the corona shows a streamer-like structure that is thought to be a visible manifestation of the sun's magnetic field.

- ¶ Spectroscopic and polarimetric observations of the light emitted by the corona, to gain information about coronal composition, temperature, magnetic fields, and motions.

- ¶ Layer-by-layer analysis of the structure of the solar chromosphere, or lower atmosphere, the puzzling transition zone between the 10,000-degree solar surface and the 3,000,000-degree corona.

- ¶ Studies of the response high in our own atmosphere to an interruption of sunlight. Normally during the day the sun's rays keep these layers in a highly ionized state; the eclipse will speed up the changes that take place in the normal day-night cycle.

Coincidentally, the last solar eclipse in the South Pacific occurred during the IGY, in October, 1958. On that occasion, rocket probes were first employed during an eclipse to detect radiations from the corona—primarily X rays—which otherwise would be lost to view through absorption by the earth's atmosphere.

The present solar eclipse is not only timely to the scientific objectives of the IQSY but also of particular interest because of its unusual length.

Near the midpoint of the eclipse path across the Pacific, the moon will cover the solar disk for more than five minutes. The maximum possible duration of the total phase of an eclipse is seven and one-half minutes; during the 1963 eclipse over Canada and the northern United States, the sun was hidden for only 100 seconds.

Plans for the U. S. eclipse expedition, in which approximately 125 American scientists and a number of their European colleagues will take part, were announced today by the participating agencies of the Federal Government and the U. S. Committee for the IQSY, which operates under the Geophysics Research Board of the National Academy of Sciences—National Research Council.

Observers will be based on four small islands in the Central South Pacific and aboard four jet transport aircraft fitted out as flying observatories. The planes will intercept the moon's shadow near the midpoint of its course across the Pacific and race briefly within it.

Two of the islands lie at the center of the 100-mile-wide path of totality, the other two at its edge. Otherwise, the shadow cast by the moon as it passes between the sun and the earth will be almost entirely over water, sweeping from the northern tip of New Zealand at sunrise to the Peruvian coast at sunset.

### Ground Observations

A dozen U. S. scientific teams are preparing for eclipse observations from the four island sites—Aitutaki, Manuae, and Rarotonga in the Cook Island group, and Bellingshausen in the Society Islands slightly to the east.

At these locations, the eclipse will be visible about 10 a.m. local time on Sunday, May 30, and totality will last nearly four minutes. (Along the path of totality, the duration of the eclipse depends on the position of the sun in the sky. The five-minute maximum will occur at the mid-point in the Pacific, where the sun will be eclipsed at its zenith; the minimum length, two minutes, will be at the end points of the path in New Zealand and Peru.)

Clear weather will be the primary concern of the ground-based observers planning direct photography or other optical measurements. Meteorological records indicate that the probability of having less than three-eighths cloud cover at this time of year is about 20 per cent, and the chance of one-fourth or less, 10 per cent. It is noted, however, that the averages reflect the usual build-up of clouds during the day, and thereby favor the early morning time of the eclipse.

Weather will be less of a concern to two other planned ground-based programs. One, involving Nike rocket firings from the island of Rarotonga into the path of totality, will, as in 1958, seek to measure the intensity of coronal X rays.

The second is a projected balloon launching from a 160-foot private schooner, the Goodwill, which will be based off Manuae. The balloon payload, floating in the lunar shadow above most of the earth's atmosphere, will include a scanning camera to survey the faint corona as distant from the sun as possible, and to record, among other phenomena, auroral and airglow emissions and the zodiacal light.

Leader of the ground expedition is Dr. A. Keith Pierce, Associate Director, Solar Division, Kitt Peak National Observatory.

## Airborne Observations

A Convair 990 and three Boeing KC 135s, each with 10 or more special viewing ports cut into its fuselage, will race along the eclipse path at 600 miles per hour, staying within the easterly-moving shadow for nine minutes or more, compared with the four minutes available to ground observers.

Air observations, like those from the ground, will be directed at the turbulent processes of the solar atmosphere, localized effects on the solar disk visible just before and just after totality, and the response of the atmosphere high above the earth to an abrupt interruption of sunlight.

The four aircraft will be flown by the Air Force Cambridge Research Laboratories, National Aeronautics and Space Administration, Los Alamos Scientific Laboratory, and the Sandia Corporation, the latter two under contract with the Atomic Energy Commission. They will make observations at 40,000 feet where the sky is naturally less bright, due to the lower density of the atmosphere and resulting decrease in scattering of light by the air and reflection from the ground. This, in turn, will enhance the contrast necessary for photographing the corona, especially at its faint far reaches.

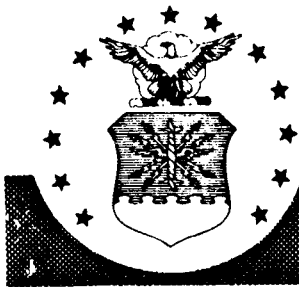
The principal problem faced by the airborne observers is stabilization of instruments and aircraft.

Federal agencies cooperating in various aspects of the eclipse expedition—in addition to those already mentioned—are: Air Force Aerospace Research Laboratories, Defense Atomic Support Agency, National Bureau of Standards, National Science Foundation, Naval Ordnance Test Station, and Office of Naval Research.

Scientists from the following institutions and laboratories, in addition to the agencies listed above, will participate in the eclipse expedition: Ames Research Center and Goddard Space Flight Center (NASA); Central Radio Propagation Laboratory (NBS); Douglas Aircraft Co.; High Altitude Observatory, National Center for Atmospheric Research; Illinois Institute of Technology Research Institute; Joint Institute for Laboratory Astrophysics, NBS and University of Colorado; Johns Hopkins University; Kitt Peak National Observatory; Los Alamos Scientific Laboratory; New York University; Sacramento Peak Observatory; Sandia Corporation; University of California at Los Angeles; University of Chicago; University of Hawaii; University of Michigan; University of Minnesota; and University of Pittsburgh.

The U. S. Committee for the IQSY, whose Chairman is Dr. Martin A. Pomerantz, Director of the Bartol Research Foundation of the Franklin Institute, Philadelphia, brought together many of the U. S. groups participating in the expedition.

The overall U. S. contribution to the international program involves work in all eight IQSY disciplines: meteorology, geomagnetism, aurora, airglow, ionospheric physics and radio astronomy, the sun and interplanetary medium, cosmic rays and geomagnetically trapped radiation, and aeronomy.



# NEWS RELEASE

UNITED STATES AIR FORCE

OFFICE of AEROSPACE RESEARCH

AIR FORCE CAMBRIDGE RESEARCH LABORATORIES

Ref. 1-65-3

Scientists from the Air Force Cambridge Research Laboratories, Office of Aerospace Research, are to study the earth's high atmosphere with three major experiments from four different stations in the South Pacific during the total eclipse of May 30. The eclipse will begin off the coast of New Zealand and will stretch across the South Pacific all the way to South America.

Two of the experiments are to be conducted via aircraft, an AFCRL KC-135 and a NASA Convair 990. Observations also are to be made from the ground by Air Force scientists from two different sites.

The largest single AFCRL (OAR) experiment, in terms of duration and equipment, is to take place aboard the AFCRL KC-135 where observations will be made of the influences of the eclipse on the earth's ionosphere. Four control flights will be made before the eclipse, and one will be made during the eclipse itself. The observations will be made at 40,000 feet. Eclipse expedition aircraft will operate from a base in the Pacific. The KC-135 will carry an ionospheric electron density recorder

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to vertically sweep a range of frequencies from 2 to 20 megacycles. Spectrographs will record the absolute intensity of several spectral lines in the visible range of light of 1.2 to 1.7 microns. Effects of the eclipse on the D-, E-, and F-layers are all of interest to the U. S. Air Force. It is hoped that a coarse electron density will be obtained of the region between 50 to 70 kilometers (about 30 to 42 miles).

A second experiment is concerned with radio waves of extra-terrestrial origin in the very low frequency range. These observations are to be made on Hervey Island in the Cook Island group. A radio receiver will be used in recording radio waves in the 6 to 26 cycle frequency range during the period of totality. On Hervey Island this period will last for three and one-half minutes. This experiment will be conducted by William Barron of AFCRL (OAR).

Two separate experiments have been designed to observe light from the sun's corona, the extended outer atmosphere of the sun. Identical instruments will be located on the ground and aboard the NASA Convair 990. These will observe the faint coronal spectrum in an effort to detect traces of certain elements and to confirm spectral recordings made during earlier solar eclipses. Observations are to be made of light in the range between 3100 and 9000 Angstroms. In addition, an image tube or light intensifier will be used to look at specific infrared regions. Joining

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AFCRL (Cont'd)...3

Dr. Richard Dunn of AFCRL (OAR) on the Convair 990 experiment will be a scientist from Geo-Science Inc., Alamogordo, New Mexico.

Dr. George W. Curtis of AFCRL (OAR) and scientists from the University of Hawaii, the High Altitude Observatory, and the Joint Institute for Laboratory Astrophysics (the latter two located in Boulder, Colorado) will jointly participate in the ground studies.

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# **NEWS RELEASE**

**UNITED STATES AIR FORCE**

## **OFFICE of AEROSPACE RESEARCH**

WASHINGTON, D.C. -- An Air Force scientist of the Office of Aerospace Research (OAR) will participate in his fifth eclipse expedition in May. Mr. Kenneth E. Kissell, assigned to OAR's Aerospace Research Laboratories (ARL), Wright-Patterson AFB, Ohio, is collaborating this year with Paul Byard, of the Ohio State University Department of Astronomy.

Members of the National Aeronautics and Space Administration sponsored expedition will study the eclipse from a modified jet airliner as the eclipse path moves across the South Pacific. Kissell's experiment will be basically the same as he used in the 1963 eclipse flying over Canada. That expedition was sponsored by the National Geographic Society and Douglas Aircraft.

In making this trip, Kissell hopes to substantiate his 1963 findings and obtain new data on the conditions existing in the outer layers of the sun.

During the May expedition, Kissell and Byard will attempt to repeat and improve upon the experiment conducted by Kissell in 1963. This experiment attempted to record at the exact beginning and ending of the eclipse, the spectral lines emitted in the infrared, from atoms in the solar chromosphere.

**MORE**

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Kissell interpreted the data to establish the conditions under which these atoms exist in the outer layers of the sun.

During the eclipse, which will last 9 1/2 minutes, Kissell and Byard will attempt to examine solar corona in the infrared region from 8,600 to 11,600 Angstroms to record possibly unknown spectral lines.

Four lines are known to exist in this region. Two are due to highly ionized iron, one to ionized calcium, and the last to neutral helium. A search will be made to see if there are other lines.

A Russian scientist in 1961 detected what appeared to be a fifth line.

The two scientists will also make a measurement of the brightness of the coronal continuum (white light). It was first detected in 1963 by Kissell, but the equipment was not designed for this aspect and the aircraft motion was too great.

The aircraft used in 1963 contained equipment which was bolted to the floor, causing the equipment to move as the plane did. This year more sensitive and better calibrated equipment will be used which contains a gyro-stabilized mirror to keep the image of the sun stable.

Kissell will use motion picture equipment this year to record the spectra, to obtain sequences, and be assured of getting data just as the sun disappears and reappears, the time of the so-called "flash" spectra.

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In 1963, Kissell recorded some 20 spectral lines before, during, and after the eclipse that had not been previously recorded, and he hopes to substantiate them this trip.

The total eclipse will last  $5 \frac{1}{3}$  minutes on the ground, but by flying and following the shadow, the eclipse will last  $9 \frac{1}{2}$  minutes for the scientists. In addition to the advantage of longer observation time, flying (at 38,000 feet) assures the scientists that no clouds will intervene. Because there is less water vapor at this altitude, better pictures can be made.

Kissell, whose main interest lies in the fields of physics and astronomy, is a member of ARL's General Physics Research Laboratory. He obtained the first flash spectrum of the sun ever recorded at the extreme photographic infrared wavelengths of 10,500 to 12,000 Angstroms during the experiment in 1963. The heart of the apparatus both in 1963 and this year is a high-quality infrared image tube which converts the invisible radiation to electrons and then to blue light.

Data obtained in 1963 is still being interpreted by Kissell. Ultimately, the data can lead to a better understanding of the atomic processes in the upper layers of the sun and to a better understanding of the atoms themselves.

Kissell has received the Department of the Air Force Special Act or Service Award, along with Darrell Frank of ARL's Metallurgy and Ceramics

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Research Laboratory, who assisted him in 1963, for his work on the solar eclipse expedition.

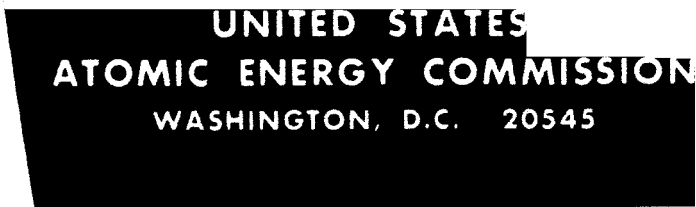
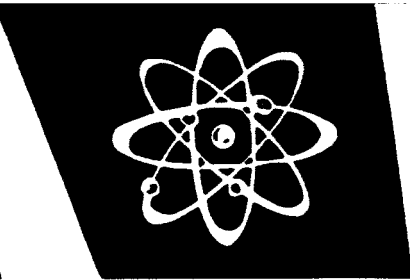
At ARL, Kissell is the principal investigator on research dealing with the applications of photoelectric image devices to astronomical spectroscopy.

He is also engaged in novel work on the recording and interpretation of short-term variations in the brightness of artificial satellites. This work involves the use of a fast-response photoelectric photometer continuously recording the brightness of the satellite during its passage overhead.

He is a consultant to the Aeronautical Systems Division Reconnaissance Laboratory on satellite acquisition and tracking for their Cloudcroft, New Mexico, electro-optical test facility.

Previous eclipse work has taken Kissell to Labrador in 1954, British Somaliland in 1955, and over Boston in 1959.

\* \* \* OAR \* \* \*



Tel. 973-3335 or  
973-3446

**TWO AEC LABORATORIES PARTICIPATE  
IN OBSERVATION OF SOLAR ECLIPSE**

Two laboratories of the Atomic Energy Commission are planning to participate in the United States' scientific program in connection with the May 30 total solar eclipse in the South Pacific. The United States scientific program of observation of the eclipse is coordinated by the National Science Foundation as part of the two-year (1964-65) cooperative effort of geophysical observations and measurements, the International Years of the Quiet Sun.

The two AEC laboratories are the Los Alamos Scientific Laboratory, Los Alamos, New Mexico, which is operated for the AEC by the University of California, and the Sandia Laboratory, Albuquerque, New Mexico, which is operated for the AEC by the Sandia Corporation.

LASL is planning two series of coronal observation experiments during the eclipse.

One of the experiment series will use airborne instruments aboard an NC 135 jet aircraft assigned to LASL. The other series will put instruments into the path of totality on Nike-Tomahawk rockets. The rockets will be fired from portable land-based launchers operated by Sandia. Sandia will also supply telemetry equipment.

The airborne laboratory will chase the eclipse in the center of the shadow, providing eight or nine minutes of eclipse totality--double the time available for ground-based observation. The shadow will be traveling easterly about 1,000 miles per hour, the aircraft about half that speed.

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Flying at about 35,000 feet, the airborne laboratory will be above the clouds, water vapor and dust which partially obscure sea level observations.

Five of the airborne experiments will be under the direction of LASL scientists, and four will be directed by scientists from Johns Hopkins University and the High Altitude Laboratory at Boulder, Colorado, working in conjunction with LASL.

Prime interest of the group is in determinations of coronal temperatures, densities and motions at this time of minimum sun-spot activity. Following are the proposed experiments:

1. Photographic photometry of inner and outer corona.
2. Detailed photoelectric photometry at selected points in the corona in the light of various emission lines.
3. Optical polarization measurements with photoelectric recording.
4. & 5. Recording, by photoelectric and photographic means, the spectral line shape of ionized iron. This important measurement of the green region in the coronal spectrum aids in determining the temperature of the corona. It is a continuation of similar measurements made by LASL personnel during previous eclipses at a time when a higher level of solar activity was present.
6. & 7. Iron emission line intensities in the ultra-violet and infra-red and polarization measurements by High Altitude Observatory.
8. Earth's air glow measurements by Johns Hopkins University.
9. Coronal spectral mapping with a scanning spectrometer by Johns Hopkins University.

The rocket experiments are to be launched from the New Zealand island of Rarotonga in the Cook Islands group. There will be four launches, during

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various phases of the two-hour eclipse phenomenon. The two-stage rockets will send instrument payloads to an altitude of 300 kilometers (about 200 miles).

Purpose of these experiments is to make spectroscopic measurements of low-energy X ray emission lines that emanate from the solar corona, the convulsive envelope of burning gas that surrounds the sun itself. It has been difficult previously to determine the nature of the origin of these "soft" solar X rays, which lie in the spectral region between 16 and 45 angstrom units. It is believed the emission lines come from atoms of carbon, nitrogen and oxygen that are highly ionized, i.e., completely stripped of their electrons.

Information regarding this energy range is of importance in determining the elemental composition of the sun and the coronal temperature.

Spectrometers in the rockets will act as a sort of camera film and the moon will perform as the camera shutter. It is planned that as the "shutter" moves across the sun the sequential launchings will make it possible to establish the origin of the emission lines. One theory is that the energy comes from near the bottom of the corona, close to the sun's surface, and may be concentrated in localized solar disturbances. These so-called plage areas will be systematically obscured by the eclipse, making it possible to use the series of spectroscopic observations for pinpointing the location of the emissions.

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As part of the rocket project, Sandia will install a launch complex consisting of four launchers and related facilities on Rarotonga. The x-ray experiments will be performed by physicists from LASL and Sandia will provide the telemetry, data acquisition and supporting ground facilities.

Sandia also has organized a scientific expedition to obtain a variety of measurements from an aircraft observatory flying above the clouds along the path of the eclipse. Along with the Sandia group, there will be experimenters from the University of Chicago, Naval Ordnance Test Station, and Edgerton, Germeshausen & Grier, Inc., aboard the aircraft.

The primary purpose of many experiments aboard the Sandia aircraft is to take advantage of the total solar eclipse to study the sun's corona. Other experiments are designed to study the upper atmosphere. In addition, Sandia's engineering capabilities will be utilized in providing a service to the scientific community.

Experiments scheduled for the Sandia aircraft observatory include photographic photometry of the outer corona, measurement of intensity variation of oxygen red and green lines, ultra violet photography of streamer characteristics, photographing visible region of spectrum for streamers, monitoring pre-chosen spectral line and background intensities, television spectrograph study of line intensities in infra-red, measurement of cosmic ray induced fast neutron flux, investigation of twinkling layer in atmosphere, air glow, and polarization and surface brightness.

The photographic photometry of the outer corona will be conducted by Edgerton, Germeshausen & Grier. The purpose of this experiment is to

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obtain absolute photometric and radiometric data of surface brightness of the solar corona at distances out to at least 10 solar radii from the sun. Outer corona brightness information will supplement data that was collected from the aircraft during the 1963 eclipse.

Indications are that a television spectrograph under development at Sandia Laboratory may be able to detect fainter lines, because of higher sensitivity, than other methods. This TV system should permit easier interpretation of line intensities, because elements in low abundance could be detected as well as weak lines of known elements.

The Earth Planetary Sciences Division of the Naval Ordnance Test Station (NOTS) at Inyokern, Calif., will conduct the air glow study and the polarization and surface brightness experiment. In the air glow experiment, an all-sky scanning, multicolor photometer will be used to study the brightness of the sky in terms of absolute units. The observations will be used to verify the existence, spectral composition, intensities, and heights of daytime air glow. This information is needed to explain and describe the interactions between the incident solar energy and the earth's atmosphere.

Polarization and surface brightness, the other NOTS experiment, is designed to obtain polarization and photometric data on the outer corona at large solar radii. From this data, electron densities and temperatures in the corona can be derived.

A Sandia-designed photometer, with a filter wheel containing 24 filters rotating in front of a photomultiplier, will be used to monitor

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pre-chosen spectral line and background intensities at various wavelengths.

In another Sandia experiment, a camera with an ultra violet lens system will be used to obtain white-light pictures. The pictures are expected to record streamer characteristics under quiet sun conditions. The visible region of the spectrum will also be investigated for streamers by using a visible camera system in another experiment.

The event camera data will be used to record where the other instruments are "looking." Recorded data would lose its significance without knowledge of just where in the corona it originated.

The Sandia recombination experiment is designed to measure the intensity variation of the oxygen red and green lines with two photometers during the solar eclipse.

A "twinkle" experiment to investigate a layer of atmosphere which apparently causes the scintillation of stars will be conducted by Sandia while the aircraft is enroute from the U. S. to the South Pacific eclipse area. The "twinkle" layer in the atmosphere is believed to be a layer of turbulence which is associated with the tropopause, perhaps lying just below it. The variation of the altitude of the twinkling layer with latitude has not been well defined. A flight across one of the distinct breaks where the tropopause rises will help make the association more positive.

The joint Sandia and University of Chicago cosmic ray experiment will involve measuring the cosmic ray induced fast neutron flux at 30,000 feet enroute to and from the southern hemisphere. The experimental apparatus for the measurement will be furnished by Prof. J. A. Simpson of the University.

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**FOR RELEASE:** FRIDAY  
March 19, 1965

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**NASA TO PARTICIPATE  
IN AIRBORNE ECLIPSE EXPEDITION**

United States and European scientists will track an eclipse of the Sun next spring making their observations high above the South Pacific from a jet aircraft provided by the National Aeronautics and Space Administration.

Data obtained will be correlated with other studies being made by U.S. and foreign scientists during the 1964-65 International Quiet Sun Year (IQSY).

The observations will be made along the path of longest totality (sun completely covered), from an altitude as high as 40,000 feet, at a long distance from land base. Because of the jet's speed in following the eclipse, experimenters will be able to observe the sun's corona during total eclipse for as much as nine minutes.

The eclipse-tracking aircraft will be the Convair 990 prototype recently acquired by NASA for research in aeronautics and space sciences. It will be operated by NASA's Ames Research Center, Mountain View, Calif.

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In cooperation with the U.S. IQSY Committee of the National Academy of Sciences, the eclipse expedition is jointly sponsored by NASA's Office of Advanced Research and Technology, the NASA Office of Space Science and Applications and the National Science Foundation. Expedition manager is Dr. Michel Bader, chief of the Physics Branch at Ames.

The eclipse will occur Sunday, May 30. The zone of total blackout will move eastward from the northern tip of New Zealand to the coast of Peru between sunrise and sunset. Except for some small islands and coral atolls, it will not pass near land.

Preliminary plans call for the scientific group to carry out a variety of experiments with the eclipse. The research plane is undergoing modifications for the experiment and for similar uses in the future. The fuselage is being altered to include 15 viewing ports, fitted with fine optical glass. The airplane will fly above five-sixths of the Earth's atmosphere to assure freedom from ordinary cloud and weather interference.

In later missions the NASA jet will be used in research programs for the national supersonic transport project and for flight studies of rough air turbulence and other safety problems of aircraft, including stability and control, performance and operations concerned with large transport airplanes.

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Experimenters will include representatives of NASA; U.S. Air Force; Douglas Aircraft Co., Santa Monica, Calif.; Joint Institute for Laboratory Astrophysics, Boulder, Colo.; University of Pittsburgh; University of Hawaii; and several foreign universities and observatories.

Solar eclipses represent the best opportunities for scientists to study the Sun's corona, or upper atmosphere.

The corona usually is not visible from the ground because of the brightness of the sky near the uneclipsed Sun. Scientists use the time available during an eclipse to measure and study the many phenomena occurring in the solar corona.

Purpose of the experiments will be to study composition, temperature, and structure of the corona. Data will complement information being obtained by NASA's Orbiting Solar Observatory program. OSO II, launched last February 3, currently is providing data on the Sun.

The eclipse studies will contribute materially to the understanding of the structure and behavior of the Sun. Solar physics is important to the national space program because of the Sun's dominating influence on the Earth's space environment and its upper atmosphere.

- 4 -

The expedition calls for precise navigation. The 600-mph aircraft must arrive within five miles of a specific point and within five seconds of the appointed time to begin observations.

Experimenters must be on the eclipse path 15 minutes in advance to ready their instruments and equipment, and stay on track 15 minutes after the Sun reappears in order to calibrate instruments.

The aerial expedition will complement island-based observations in which NASA also is participating.

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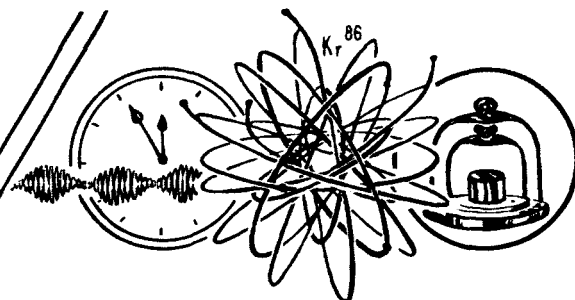
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## SOLAR ECLIPSE EXPEDITION

Joint Institute for Laboratory Astrophysics  
(National Bureau of Standards - University of Colorado)

The total eclipse on May 30, 1965, will provide the longest period of totality for about 10 years, and will provide an opportunity to make studies of the structure of the outer atmosphere of the sun not possible in any other way.

An extremely important part of the sun's atmosphere is the chromosphere, the transitional layer between the bright disk of the sun and the three-million degree solar corona which reaches out into space. The faint light from the chromosphere can reveal to us the details of surface storms on the sun--flares, eruptions, and other phenomena--which affect the earth's atmosphere through particle and x-ray bombardment. In addition, the chromosphere produces most of the ultra-violet and x-ray light which maintains our ionosphere, thereby making possible circumglobal radio communications.

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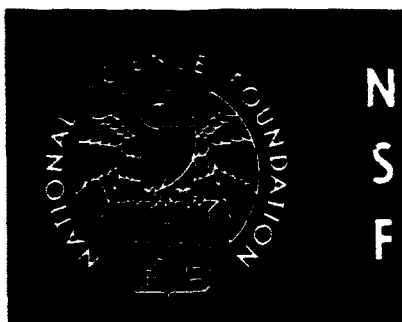
At the Joint Institute for Laboratory Astrophysics, a new type of instrument has been developed to permit a 10-fold improvement in measurements of the variation of intensity with height above the solar limb. This photoelectric spectrometer will automatically follow the intensity of different colors from the chromosphere as the moon's edge gradually passes through the outer solar atmosphere. Two of these instruments are being assembled at JILA, having been conceived and designed mainly by Dr. J. E. Faller of the NBS Laboratory Astrophysics Division at JILA, and Dr. J. T. Jefferies, (Formerly at JILA, and now at the University of Hawaii) a non-resident fellow of JILA and part-time staff member of the Laboratory Astrophysics Division. The two instruments are designed to look at somewhat different spectral regions but with some overlap. They will be located on different islands (about 400 miles apart) thus almost doubling the likelihood of clear observing weather.

One of the instruments will be taken to the French island of Bellingshausen by Dr. Faller, his graduate student Mr. Spencer Weart, and Dr. Jefferies. They will join forces with Dr. Orrall (University of Hawaii and Sacramento Peak Observatory) and Dr. G. W. Curtis (Sacramento Peak Observatory), who will be performing an experiment on the solar corona. This joint group, with Dr. R. Dunn (Sacramento Peak) is also collaborating in an airborne version of the same coronal experiment.

The second of the two JILA instruments is being provided to Dr. William Protheroe and Mr. Edward Devinney (University of Pennsylvania) who are collaborating with the New Zealand Mt. John Observatory and making the observations on the New Zealand island of Manuae. Dr. John Hall of the NBS Laboratory Astrophysics Division and JILA will accompany the instrument to Manuae and join with the Pennsylvania and New Zealand astronomers in this observing program.

The JILA expedition is sponsored by the National Bureau of Standards, the National Aeronautics and Space Administration, and the Air Force Sacramento Peak Observatory.





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**NSF-SUPPORTED SCIENTISTS TO STUDY  
SOLAR CORONA DURING TOTAL ECLIPSE**

Scientists from the NSF-supported Kitt Peak National Observatory, Tucson, Arizona, and the High Altitude Observatory of the National Center for Atmospheric Research, Boulder, Colorado, will conduct land-based and in-flight studies of the sun's fiery corona during the May 30 solar eclipse over the Pacific Ocean.

The expedition, part of the International Years of the Quiet Sun (IQSY) research program, will give scientists an opportunity to observe the sun's corona during a period of minimum solar activity.

The corona is the most important of the celestial phenomena that can be recorded only when a total eclipse blots out the sun's direct light. Tenuous and thin near the earth in comparison with its structure near the sun, the corona stretches beyond the earth, enveloping it, and forming the environment through which our planet moves in its orbit.

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Land-based scientists will work from island bases in the South Pacific Ocean.

Dr. A. K. Pierce, Director of the Kitt Peak National Observatory, and leader of the United States ground-based expeditions, will study the corona in order to get better values of its pressure, density, and temperature. To increase his chances for clear skies overhead, he and his associates will take spectrograms of the corona from two different islands.

Spectrograms are used to determine electron distribution and to obtain information about the temperature of particular kinds of atoms in the corona. The Kitt Peak groups will use 12-inch coelostat (sky stationary) mirrors with their spectrographs. The coelostat mirror is used to divert the moving solar image into the stationary telescope of the spectrograph.

Another project of the Kitt Peak astronomers is to study brightness distribution of the corona. This group hopes to record the distribution of electrons in the corona. The astronomers will use a coelostat mirror to obtain an image of the sun, and will then scan it with moving photo cells to build a brightness picture of the corona in three wave lengths (blue, yellow, and red).

The High Altitude Observatory will be involved in three studies, one land-based, and the other two in the air. In all three investigations the Boulder scientists will study the phenomena of highly ionized atoms that cause coronal light. They will also seek proof of the existence of a magnetic field in the inner-corona, that part of the corona closest to the sun.

Drs. John Firor and John Eddy will conduct a cooperative island-based study with Dr. John Malville, of the University of Michigan. They will observe the special features of light emitted by high temperature iron atoms. The temperature of the iron atoms is estimated at about one million degrees centigrade.

The other two studies will be conducted from an Air Force-manned Atomic Energy Commission airplane from Los Alamos. Dr. Malville, Dr. Firor, and Dr. Eddy will duplicate their experiment in the study of ionized iron

atoms, and will also make measurements of linear polarization of light of a particular wavelength emitted by the corona. This light produces a green line in the corona's visual spectrum.

The third study will be by Dr. Firor in cooperation with Dr. Charles Hyder of the University of California at Los Angeles. By studying linear polarization in the green coronal line, the two researchers hope to find evidence that a magnetic field does exist in the inner corona. The green coronal line is the strongest emission line in the corona, and the most easily detectable. According to their calculations there is considerable polarization in the line.

As part of his role as leader of the U.S. ground-based expedition, Dr. Pierce has arranged a sea transport service for scientists participating in ground-based studies. "The Goodwill," a 160-foot schooner, will leave Los Angeles for the South Pacific the first week in April.

The schooner will transport scientific equipment to be used in land-based investigations; during the eclipse it will anchor off Manuae, and will be used as a balloon-launching site for a study conducted by scientists from the University of Minnesota.

The 2,000-ton schooner makes about 12 knots and has a crew of 19. Some 30 scientists will be passengers on "The Goodwill's" trips between the Pacific islands. Kitt Peak, with a special grant from the National Science Foundation, will pay for the crew's salary and food, as well as ship repair, insurance, and other operational costs. The schooner is owned by Mr. Ralph Larrabee of Los Angeles and is on rent-free loan to Kitt Peak for the expedition.

The Foundation is also supporting special modification and equipment changes in the National Aeronautics and Space Administration aircraft, to be used by a number of the scientists, to prepare it for the solar eclipse research projects.

In addition to funding many fundamental research projects that are part of the IQSY program, the NSF also coordinates the IQSY activities of participating Federal agencies.

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U. S. NAVAL ORDNANCE TEST STATION  
CHINA LAKE, CALIFORNIA

# NEWS RELEASE



CHINA LAKE, Calif.:—Three major objectives of scientists attached to the U.S. Naval Ordnance Test Station were described here this week in conjunction with the forthcoming airborne observations of the solar eclipse scheduled to occur May 30, 1965.

William C. White and James G. Moore, astronomers working with the Earth and Planetary Sciences Division, are to participate in this year's joint program.

White's objective this year will be to obtain polarization and photometric data on the outer corona at large solar radii. From this data, electron densities and temperature in the corona can be derived.

His equipment for obtaining this data includes a K-24 aerial camera back fitted with a mounting for four lenses, each with a narrow band interference filter mounted in front of it.

The lens mount can be rotated which allows exposure for each filter to be obtained for three polarization angles and one exposure for coronal brightness alone.

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U. S. NAVAL ORDNANCE TEST STATION, an activity of the Bureau of Naval Weapons, Department of the Navy, is located 155 miles northeast of Los Angeles, on the north Mojave Desert. Additional facilities of the Station are located at Pasadena, Long Beach, and San Clemente Island, California. The mission of the Station is to conduct research, design, development, limited production, test, and technical evaluation of complete weapons systems, their components and assemblies, principally in the fields of rockets, guided missiles, underwater weapons, and aircraft fire control.

## ECLIPSE - 2

Moore's objectives during the flight will be to study the existence, spectral composition, intensities and heights of day air glow. The verification of his studies are needed to explain and describe the interactions between incident solar light and the earth's atmosphere.

At the time of the solar eclipse, the day air glow can be detected, since the scattered sunlight - which is a detriment to normal observations - is greatly reduced. It is even further reduced when observations are made in the stratosphere, instead of on the ground.

Moore proposes the use of an all-sky scanning, multi-color photometer, installed in one of the 15-inch hemispheric domes for measurements of sky brightness.

The photometer will measure - in terms of solar surface brightness or other absolute units such as Rayleighs - the brightness of the sky in, from four to eight discreet wavelength intervals.

In addition, Moore will attempt to measure the relative contributions of primary and higher order scattering (of sunlight) to the illumination of daytime sky.

In making his observations at altitudes above the tropospheric dust layer, he feels that his measurements will be particularly meaningful and provide valuable data for further research and application.

The initial airborne observation of a solar eclipse - which permitted scientists to conduct a two-minute study of the phenomena - proved feasibilities that paved the way for this year's program.

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ECLIPSE - 3

Officials predict they will be able to conduct studies of this year's eclipse up to eight minutes. The eclipse is to occur in the South Pacific Ocean latitudes.

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### HIGH ALTITUDE BALLOONS TO BE LAUNCHED FROM SAILING VESSEL TO OBTAIN ECLIPSE DATA

The technique of launching a high altitude balloon with a scientific payload from the deck of a sailing vessel was successfully tested in late January in preparation for the IQSY eclipse expedition. On May 30, 1965, the day of the next total eclipse of the sun, which will be seen only in the South Pacific, two balloons will be launched in succession from the 160-foot schooner GOODWILL to obtain photographs and data on the outer corona during the period of totality.

The experiment will be conducted by Dr. Edward Ney of the University of Minnesota in a project jointly sponsored by the Office of Naval Research and the National Aeronautics and Space Administration. The 100,000 cubic-foot balloons will be launched while the schooner is within 30 miles of Manuae, one of the two islands from which major ground observations of the eclipse will be made.

Dr. Ney participated in the observations of the 1959 total eclipse viewed from French West Africa and the 1963 eclipse seen from Maine. Collection of eclipse data is part of a long-range basic research program in atmosphere and solar physics conducted by the University of Minnesota under a contract with ONR. The 1959 eclipse measurements were made during a period of maximum solar activity in contrast to the 1965 eclipse when solar activity will be at a minimum. Comparison of the data is expected to throw new light on how energy is transported from the sun through the corona on its way to the earth.

Dr. Ney first used high altitude balloons for eclipse studies during the 1963 eclipse. The purpose is to overcome the problem of sky brightness during totality which makes it extremely difficult to observe the dim outer corona from the ground. Distortion caused by the earth's atmosphere is also eliminated by balloon flights. At that time he successfully flew two balloons, launched from a ground site in Maine, each carrying eight cameras. The balloons reached an altitude of 110,000 feet and a point within five miles of the centerline of the eclipse during totality. (The centerline of the eclipse is the course of the sun from sunrise to sunset while it is in total eclipse. Closeness to the centerline lengthens the duration of totality.)

ONR has pioneered in the launching of large balloons to carry scientific instruments to high altitudes since 1946. Navy ships have been used as launching platforms for some time, but flights from sailing vessels have not been previously attempted.

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During trials aboard the GOODWILL off the coast of Baja California in late January different launching procedures were tried out to take into account the various wind and sea conditions that may exist at the time of launch. One method was a conventional vertical launch, with the balloon and the payload beneath it rising 100 feet straight up into the air just before launch. Another technique involves placing the payload in a 30-foot boat towed by the schooner, with the balloon lifting the payload from the small boat at launch.

In three successful test launches the balloons lifted off within a minute or two of the scheduled time. The balloons, which reached 100,000 feet, carried scientific instruments that gathered data on zodiacal light.

During the eclipse each of the two balloons will carry four cameras and a special telemetering telescope designed by Dr. Ney, which will be used to measure the polarization of coronal light. In addition, he will set up two electronic telescopes, one on Manuae and another on Bellinghausen, which is the other island to be used by the IQSY eclipse expedition. These instruments will also measure the polarization of the corona in different wave lengths, supplementing the data obtained from the balloon telescope.

It is anticipated that the combination of ground and balloon-borne instruments will provide more comprehensive data on the sun's corona than has been previously obtained.